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Credelle

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[54] **FLAT DISPLAY TUBE HAVING SHIELDING MEMBER BETWEEN BEAM GUIDE AND SCREEN**

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[51] **Int. Cl.**[3] **H01J 29/04;** H01J 31/08

[52] **U.S. Cl.** **313/422**

[58] **Field of Search** 313/422; 315/366

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,858,464	10/1958	Roberts	313/422 X
4,088,920	5/1978	Siekanowicz	313/422
4,115,724	9/1978	Endriz	313/422 X
4,121,130	10/1978	Gange	313/409 X

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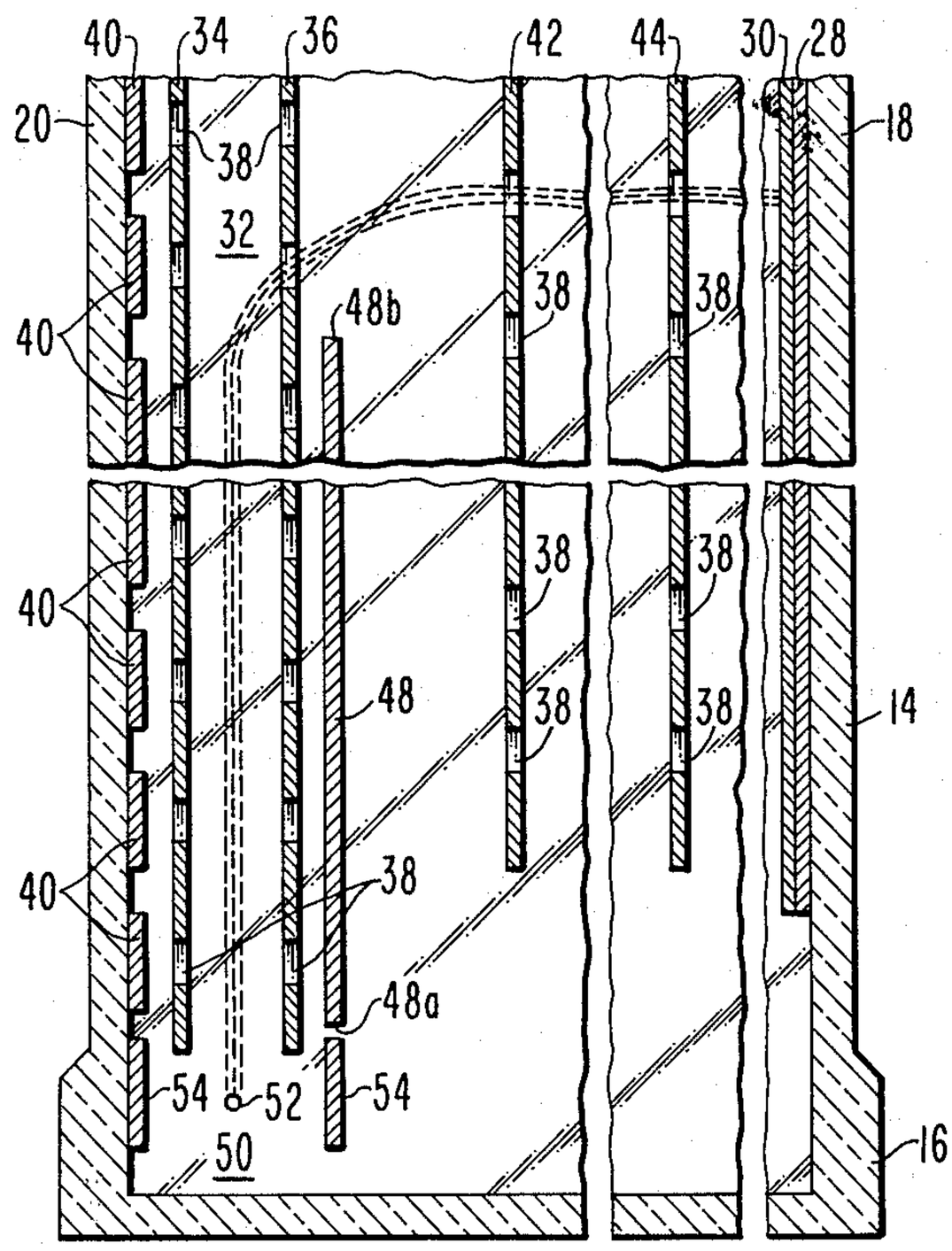
[57] **ABSTRACT**

An evacuated envelope includes substantially parallel front and back walls with a cathodoluminescent screen on the front wall. Within the envelope, in spaced relation to the back wall and substantially parallel to the screen, it is an electron beam guide comprising a pair of spaced apart, elongated guide grids having a plurality of apertures therethrough. At one end of the beam guide is an electron beam generating and directing means which directs at least one beam of electrons between the guide grids. A shielding member is disposed between the screen and the beam guide adjacent to the electron beam generating means.

2 Claims, 2 Drawing Figures



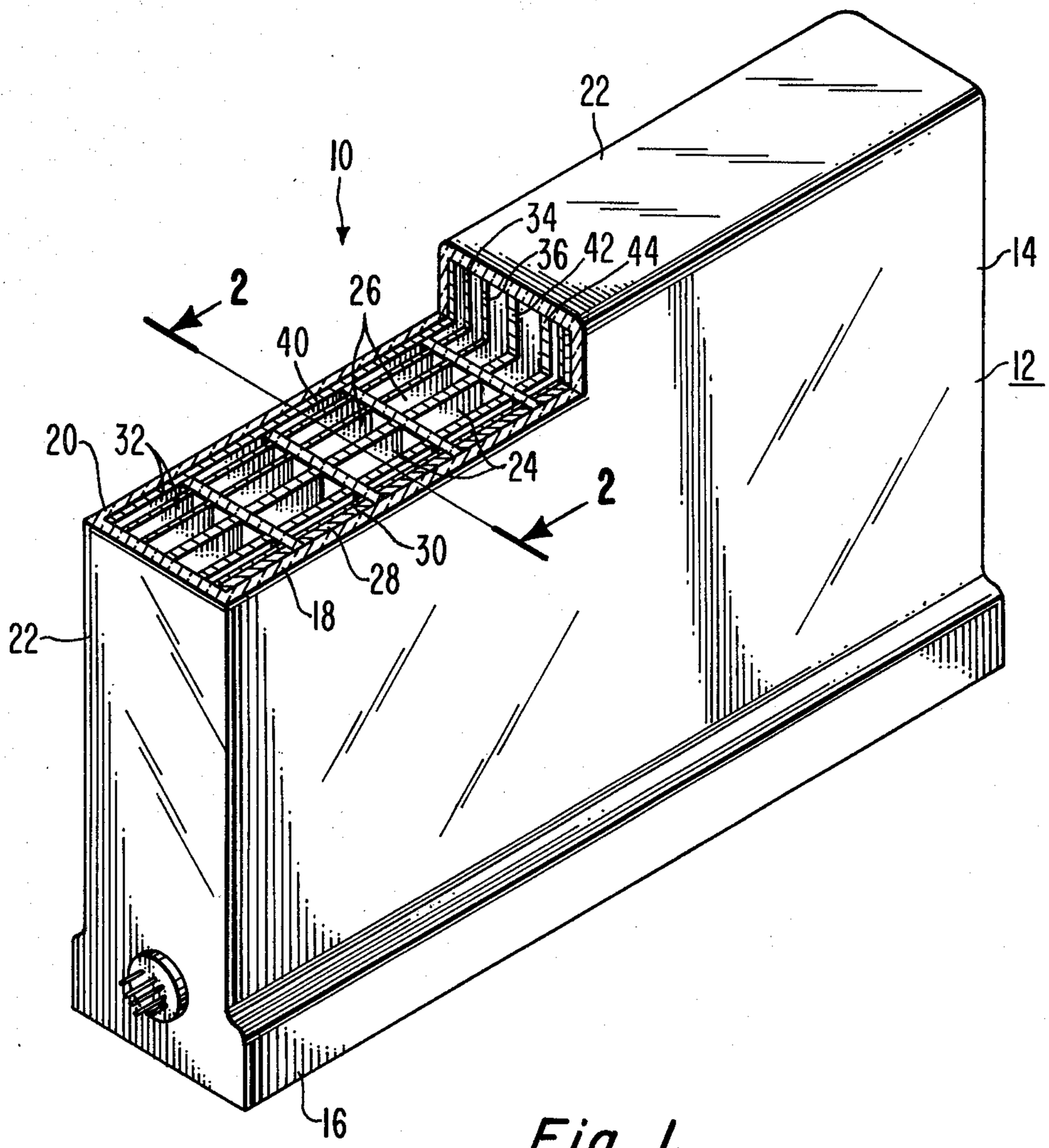
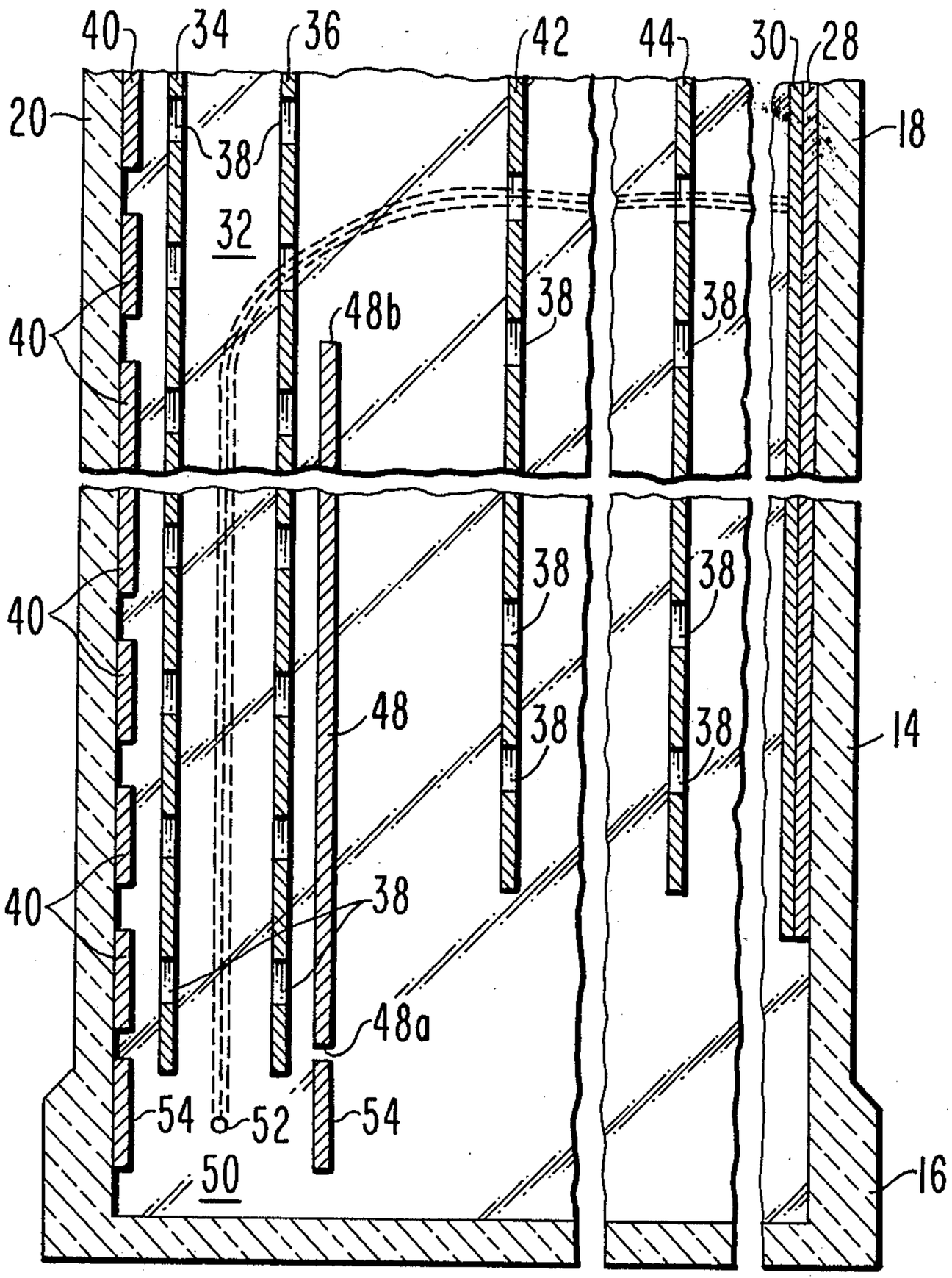


Fig. 1.


40
34
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44
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32
18
48b
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38
14
40
48
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48a
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52
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50
16

Fig. 2.

FLAT DISPLAY TUBE HAVING SHIELDING MEMBER BETWEEN BEAM GUIDE AND SCREEN

BACKGROUND OF THE INVENTION

The present invention relates to image display device having electron beam guides, and more particularly to a means for shielding the electron beams, as the beams enter the beam guides, from perturbing electric fields.

Recently, flat image display devices have been suggested utilizing a plurality of electron beam guides to direct electron beams to various positions on a cathodoluminescent screen. One type of these devices is described in U.S. Pat. No. 4,088,920 issued May 9, 1978 to W. W. Siekanowicz et al. entitled "Flat Display Device with Beam Guides." The electron beam guides in these devices comprises apertured plates which are biased so as to establish an electric field balance between two of the adjacent parallel plates. At the midpoint between the two adjacent plates, the electric fields are symmetrical so that an electron beam injected between the two plates will be confined by the balanced electric fields and guided in a path parallel to each of the plates. The Siekanowicz et al. patent also discloses that the display device may be provided with additional grids between the beam guides and the screen. These additional grids serve as focusing and accelerating grids for the electron beams as the beams flow from the beam guide to the phosphor screen. The potentials on the focus grid, acceleration grid, and screen electrode generate electric fields which can penetrate into the beam generating cathode region and perturb the electric fields around the cathode causing nonuniform injection of the electron beams into the beam guide. The electric fields generated by the modulation electrodes, the focusing and accelerating grids, and the screen electrode can also penetrate into the beam guide and perturb the fields in the critical transition region which extends within and along the beam guide for a longitudinal distance equal to at least the first transverse row of apertures. It is highly desirable in such display devices to shield the cathode region and the transition region from the perturbing electric fields emanating from the ends of the display device elements which cause nonuniform electron beam injection into the beam guides and also distort the balanced fields within the guides.

SUMMARY OF THE INVENTION

A display device has an evacuated envelope, a cathodoluminescent screen, a beam guide and an electron generating and directing means at one end of the beam guide. A shielding means disposed between the screen and the beam guide has its proximal end adjacent to the electron generating and directing means.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view, partially cut-away, of a display device embodying the present invention.

FIG. **2** is a sectional view taken along line **2**—**2** of FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1** and **2**, one form of a flat display device utilizing the shielding member of the present invention is generally designated as **10**. The display device **10** comprises an evacuated envelope **12**, typically of glass, having a display section **14** and an electron gun section **16**. The display section **14** includes a rectangular front wall **18** which supports a viewing screen **28** and a rectangular back wall **20** in spaced, parallel relation with the front wall **18**. The front wall **18** and back wall **20** are connected by side walls **22**. The front wall **18** and back wall **20** are dimensioned to provide the size of the viewing screen desired, e.g. 75 by 100 cm, and are spaced apart about 2.5 to 7.5 cm.

A plurality of spaced, parallel support walls **24** are secured between the front wall **18** and the back wall **20** and extend from the gun section **16** to the opposite side wall **22**. The support walls **24** provide the desired internal support for the evacuated envelope **12** against external atmospheric pressure and divide the display section **14** into a plurality of channels **26**. On the inner surface of the front wall **18** is the phosphor screen **28**. The phosphor screen **28** may be of any well known type presently being used in cathode ray tubes, e.g., black and white or color television display tubes. A metal film electrode **30** is provided on the phosphor screen **28**.

The gun section **16** is an extension of the display section **14** and extends along one end of the channels **26**. The gun section may be of any shape suitable to enclose a particular gun structure **50** contained therein. The electron gun structure **50** contained in the gun section **16** may be of any well known construction suitable for generating at least one beam of electrons into each of the channels **26**. For example, the gun structure may comprise a plurality of individual guns mounted at the ends of the channels **26** for directing separate beams of electrons into the channels. Alternatively, the gun structure **50** may include a plurality of modulation electrodes **54** and a line cathode **52** extending along the gun section **16** between the modulation electrodes **54**. The line cathode **52** also extends across the ends of the channels **26** and is adapted to generate electrons which can be selectively directed as individual beams into the channels. A gun structure of the line type is described in U.S. Pat. No 4,121,130 to R. A. Gange, issued Oct. 17, 1978, entitled "Cathode Structure and Method of Operating the Same."

In each of the channels **26** is a beam guide **32** for focusing and periodically confining electrons into a beam which travels in a path along the guide **32**. The guide **32** includes a pair of elongated, spaced apart, parallel first and second guide grids **34** and **36** respectively, each having a plurality of apertures **38** therethrough. The apertures **38** are arranged so as to define a plurality of rows transversely across and columns longitudinally along the guide grids **34** and **36**. A plurality of spaced, parallel conductors **40** are disposed on the inner surface of the back wall **20** and extend transversely across the channels **26**. The conductors **40** are strips of an electrically conductive material, such as metal, coated on the back wall **20**. Each of the conductors **40** lies directly opposite a transverse row of apertures **38** in the first guide grid **34**. Means are provided for deflecting the beam out of the guide and toward the phosphor screen **28** at various points along the length of the channels **26**.

In each of the channels **26** a focusing grid **42** may be located in spaced relation between the beam guide **32** and the metal film electrode **30** on the phosphor screen **28**. An accelerating grid **44** may be interposed between the focusing grid **42** and the metal film electrode **30**. The focusing grid **42** and the accelerating grid **44** also have a plurality of apertures **38** therethrough. Grids **42**

and **44** serve as focusing and accelerating means respectively, for the electron beams as the beams flow from the beam guide **32** to the phosphor screen **28**.

A non-apertured shielding member **48** is fixedly attached by insulator supports (not shown) to the beam guide **32**. The shielding member **48** has a proximal end **48***a* located adjacent to the electron gun structure **50**. The shielding member **48** comprises an electrode located in spaced, parallel relation to the second guide grid **36**. The member **48** may be made of any suitable conductive material, such as cold-rolled steel or beryllium-copper. The thickness of the member **48** is substantially identical to the thickness of the second guide grid **36**. The member **48** extends transversely across the channel **26** so as to substantially shield the cathode region within the gun structure **50** and the transition region of the beam guide **32** from the ends of the focusing grid **42**, the accelerating grid **44**, and the metal film electrode **30**. For reasons which will be explained later, the member **48** extends longitudinally along the channel **26** so as to overlap at least the first transverse row of apertures **38** and preferably the first six rows of apertures **38** in the second guide grid **36**. The member **48** has a distal end **48***b* which terminates between two adjacent rows of apertures **38**. The member **48** is preferably spaced from the second guide grid **36** of the beam guide **32** a distance substantially equal to the spacing between the first guide grid **34** and the conductors **40** on the back wall **20**.

In the operation of the display device **10** incorporating the above described shielding member **48**, a positive potential, typically about 80 volts, is applied to the first and second guide grids **34** and **36**. A relatively high positive potential, typically about 350 volts, is applied to each of the conductors **40** on the back wall **20** and to the shielding member **48**. A high positive potential, typically 2000 to 10,000 volts is applied to the metal film electrode **30** on the phosphor screen **28**. The same high positive potential that is applied to the metal film electrode **30** may also be applied to the accelerating grid **44** if the device is provided with such an additional grid. A positive potential typically 1000 volts, which is higher than the potential applied to the first and second guide grids **34** and **36** but lower than the potential applied to the metal film electrode **30**, may be applied to the focusing grid **42** if such a grid is included in the display device.

Beams of electrons are directed along paths from the gun section **16** into the channels **26** between the guide grids **34** and **36** of the beam guides **32**, with each beam being directed along a longitudinal column of guide grid apertures **38**. The potential difference between the guide grid **34** and the conductors **40**, and the potential difference between the guide grid **36** and the metal film **30** of the phosphor screen **28** or the resultant potential on both the focusing grid **42** and the accelerating grid **44** in those devices having these additional grids, creates an electrostatic force field within the space between the guide grids **34** and **36** as described in the Siekanowicz et al. patent. This electrostatic field applies forces to confine the electrons into beams which travel along a substantially straight path between the guide grids **34** and **36**.

The relatively high positive potential applied to each of the conductors **40** on the back wall **20** and to the shielding member **48** creates symmetrical electric fields in the critical transition region within the beam guide **32**. The transition region is the region of the guide **32** which extends along the guide **32** for a longitudinal distance equal to at least the first transverse row of apertures. The symmetrical fields from the shielding member **48** and the conductors **40** shield out the perturbing fields which emanates from the ends of the device elements such as the modulation electrodes **54**, the focusing grid **42**, the accelerating grid **44**, and the metal film electrode **30** and which would otherwise penetrate into the transition region of the guide **32** through the apertures **38**.

The close proximity of the modulation electrodes **54** and the distal end **48***a* of the shielding member **48** also prevents the perturbing fields which emanate from the ends of the metal film electrode **30** and grids **42** and **44** from penetrating into the beam generating cathode region within the electron gun structure **50**.

It has been determined that the perturbing fields from the ends of the modulation electrodes **54** have a negligible effect on the electron beams within the guide **32** if the shielding member **48** has a minimum length equal to twice the spacing between the second guide grid **36** and the focusing grid **42**. Thus, if the spacing between the second guide grid **36** and the focusing grid **42** is 125 mils (3.175 mm) a shielding member **48** having a length of 250 mils (6.35 mm) would be sufficient to shield the electron beam within the guide **32** from the perturbing fields emanating from the modulation electrodes **54**.

However, a length greater than the minimum length of 250 mils (6.35 mm) is required to minimize the deleterious effect of the perturbing fields emanating from the ends of the metal film electrode **30** and the grids **42** and **44** on the transition region of the guide **32**. It has been determined that an additional 500 mils (12.7 mm) should be added to the minimum length of the shielding member **48** to obtain the shielding necessary for optimum device operation.

Thus, in the preferred embodiment, which has a center-to-center spacing of about 125 mils (3.18 mm) between adjacent transverse rows of apertures **38** in the beam guide **32**, a shielding member **48** having a length of 750 mils (19.05 mm) would cover the first six transverse rows of apertures **38** of the beam guide **32**. As shown in FIG. **2**, the ends of the grids **42** and **44** and the metal film electrode **30** should overlap the distal end **48***b* of the shielding member **48** by about 500 mils (12.7 mm) so that the electric field balance within the transition region of the beam guide **32** is not adversely affected by the perturbing fields emanating from the ends of the abovementioned elements **30**, **42** and **44**.

The distal end **48***b* of the shielding member **48** should terminate between adjacent transverse rows of apertures **38** in the second guide grid **36** in order to minimize the edge effect of the electric field from the shielding member **48** on the field balance within the beam guide **32**.

While the shielding member **48** is described above as being spaced from the second guide grid **36** a distance that is approximately equal to the spacing from the first guide grid **34** to the conductors **40** on the back wall **20**, it should be clear that this spacing, while preferred, is selected to permit the same potential to be applied to the member **48** and the conductors **40** to create symmetrical electric fields in the transition region of the beam guide **32**. The spacing between the shielding member **48** and the second guide grid **36** may either be increased or decreased from the preferred spacing provided the potential applied to the member **48** is also changed to re-establish field symmetry in the transition region.

Where the spacing between the second guide grid **36** and the focusing grid **42**, or the screen electrode **30** in a device not having a focusing grid **42**, is decreased from that preferred spacing indicated above, the minimum length of the shielding member **48** should be sufficient to overlap at least the first transverse row of apertures **38** in the second guide grid **36**. The shielding member **48** should terminate between the adjacent transverse row of apertures **38** in the second guide grid **36** for the reason discussed above.

I claim:

1. In a display device having an evacuated envelope with substantially parallel front and back walls,

a cathodoluminescent screen on the front wall,

an electron beam guide in spaced relation to said back wall, said beam guide being disposed substantially parallel to said screen, said beam guide comprising a pair of spaced apart, elongated guide grids having a plurality of apertures therethrough, said apertures being arranged so as to define a plurality of rows across and columns along said guide grids,

means at one end of said beam guide for generating and directing at least one beam of electrons between said guide grids, the improvement comprising:

conductive shielding means in spaced parallel relationship to said beam guide having a proximal end adjacent to said electron generating and directing means, said shielding means being disposed between said screen and said beam guide and extending along said beam guides so as to overlap at least the first row of apertures on the screen side of said beam guide, said shielding means having a distal end which terminates between adjacent rows of apertures.

2. The device as in claim **1**, wherein said shielding means is spaced from the screen side of said beam guide a distance equal to the spacing between the back wall side of said beam guide and the back wall.

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